REMARKS

Amendments

Independent claim 1 and dependent claim 5 has been amended to specify the feed to the present single- step process catalytic dewaxing process is a slack wax or a foots oil, support for which is found on page 3 of the specification, lines 23-24.

Claim 1 has also been amended to specify the preferred zeolite employed in the present process as a MTW type zeolite, and to specify the preferred average crystallite size as less than 0.10 μm. Support for these amendments is found on page 6 of the specification, lines 2-3 and 12-17.

Claim 1 has been further amended to recite that the product effluent from the present process has a gas oil yield of at least 20 wt%. Support for this amendment is found on page 13 of the specification, Table 2, which shows a gas oil yield of 20.9 wt%.

Claim 2 has been to specify feed is a slack wax having an oil content of between 0 and 50 wt%. Support for this amendment is found on page 3, lines 30-31.

Claim 3 has been amended to specify the slack wax feed have an oil content of between 0 and 20 wt%, which is disclosed on page 4 of the specification, lines 5-7.

Claim 4 has been amended to specify the feed is a foots oil feed and contains between 80 and 95 wt% wax. Support for this amendment is found on page 3 of the specification, line 34 to page 4, line 1.

Claims 6 and 7 have been amended to correct the spelling of the word "constraint" and to specify the zeolite is a MTW type zeolite, consistent with the amendment to claim 1.

Claim 8 has been amended to specify the MTW type zeolite crystallites have an average crystallite size of 0.05 μm, support for which is found on page 11 of the specification, lines 15-17.

Claim Rejections – 35 USC § 103

The Rejection of Claims 1-9 Under 35 U.S.C. 103 (a) as being Unpatentable Over Van Ballegoy et al (WO 00/29511) ("Ballegoy") in View of Chen et al (Molecular Transport and Reaction in Zeolites, Table 2.1, page 11, John Wiley and Sons, 1994 ("Chen") and evidenced by Young (US Patent 3,864,282) ("Young") is Respectfully Traversed.

The Present Invention

The present invention is directed to a single step process for preparing both a lubricating base oil and a gas oil in high yields from waxy feeds, in particular slack waxes and foots oil, as now recited in present claims.

With the present process the gas oil product yield is greater than 20 wt%, and is larger than the fraction boiling below the gas oil fraction. Also, the gas oil product obtained by this process has very good cold flow properties like cloud point and cold filter plugging point (Specification, page 3, lines 9-18 and 21-24, and page 13, lines 11-15 and Table 2).

The inventive process uses a particular type of zeolite-containing catalyst, i.e., a MTW type zeolite catalyst having 12 oxygen-ring defined pores. The MTW type zeolite crystallites employed in the present process have an average crystal size smaller than 0.1 and a constraint index larger than 1.0 (Specification, page 2, lines 22-32 and page 6, lines12-17).

The specific combination of features being relied on to distinguish the claimed process over the prior art include use of a slack wax or foots oil feed; the use of a MTW type zeolite crystallites having an average crystallite size of smaller than 0.1 and a constraint index larger than 1.0; and yielding a product effluent comprising a base oil fraction and a gas oil fraction wherein the yield of the gas oil fraction is at least 20 wt%, and is larger than the fraction of the product effluent boiling below the gas oil fraction.

Comparative Showing

The unexpectedly high gas oil yields obtainable by the MTW type zeolite having a average crystal size smaller than 0.1 μm is shown in Table 2 on page 13 of the specification, which compares the results obtained by contacting a slack wax with a catalyst comprising a MTW type zeolite having an average crystal size of 0.05μm (Example 1) to a state of the art MTT type zeolite containing catalyst (Comparative Experiment A). The MTW type zeolite used in Example 1 produced a gas oil yield of 20.9 wt %. The yield of the fraction boiling below the gas oil fraction (the sum of kerosene yield and the naphtha minus yield) was 16.3 wt %, which is less than the yield of the gas oil fraction. The MTT type state of the art zeolite produced only 8.8 wt% gas oil and a much larger fraction (39.9 wt%) boiling below the gas oil fraction. These results were unexpected and not at all obvious from the teachings of the prior art.

As discussed in greater detail below, the aforementioned combination of features, and the highly advantageous and unexpected results shown in Table 2 on page 13 of the specification, are not taught or reasonably suggested by the prior art.

Ballegoy

Ballegoy, the primary reference, discloses a process for catalytically dewaxing a hydrocarbon feed to produce lubricating base oils in high yield. There is no mention in Ballegoy of gas oils, or of a desire to produce gas oils, and certainly no teaching of how to produce a gas oil fraction in a yield of at least 20 wt%, with the gas oil fraction being larger than the product effluent boiling below the gas oil fraction. Both of the underlined features are recited as limitations in the amended claims.

The invention in Ballegoy is based on the finding that the use of a relatively low ratio of metallosilicate crystallites to binder (i.e., between 5:95 and 35:65), results in a higher yield of base oil product at the same weight hourly space velocity than if a higher ratio of metallosilicate crystallites to binder were used (page 2, lines 1-6).

Ballegoy discloses that a wide variety of metallosilicate crystallites can be employed to make catalysts useful in the claimed catalytic dewaxing process. Preferred metallosilicate crystallites are aluminosilicate crystallites having a pore diameter in the range of from 0.35 to 0.80 nm (page 7, lines 5-15).

Preferred aluminosilicate crystallites are said to include MFI-type zeolites, e.g., ZSM-5, silicalite, offretite, and zeolites of the ferrierite group, such as ZSM-35 and ferrierite (page 7, lines 15-20).

Another preferred class of aluminosilicate zeolite crystallites are said to include TON-type zeolites, such as ZSM-22, Theta-1 and Nu-10 (Page 7, lines 21-24).

A further preferred class of aluminosilicate zeolite crystallites are said to include MTW-type zeolites, such as ZSM-12, Nu-13, TEA silicate, TPZ-3, TPZ-12, VS-12,and Theta-3 (page 7, lines 25-29).

A next preferred class of aluminosilicate zeolite crystallites are said to include MTT-type zeolites, such as ZSM-33, SSZ-32, ISI-4, KZ-1, EU-1, EU-4 and EU-13 (page 7, line 30 to page 8, line 1).

The Ballegoy reference contains thirteen examples and three comparative experiments using various catalysts containing ZSM-5, ZSM-12, SSZ-32, TON-type zeolites. The yields and properties of the <u>lubricating base oil products</u> obtained in these examples and comparative experiments is shown in Table II, III, V, VIII, X and XII. None of these examples or comparative experiments shows the production of <u>gas oils in high yields of at least 20 wt%.</u>

Ballegoy contains inconsistent teachings regarding average crystal size. On page 12, lines 1-4, Ballegoy discloses that "Preferably crystallites smaller than 10 microns and more preferably smaller than 1 micron are used. The practical lower limit is suitably 0.1 micron." On page 12, lines 8-9, Ballegoy discloses that: "Preferable catalysts are used having a crystallite size between 0.05 and 0.2 μm." This latter disclosure is in conflict with the earlier disclosure which taught the lower practical limit of the crystallites size is 0.1. The subsequently disclosed range of between 0.05 and 0.2 μm includes values less than the stated lower practical limit. Based on these conflicting teachings, one skilled in art would be discouraged from using crystallites having average crystal sizes at the lower end of the stated range

In any case, the significant point is that Ballegoy contains no teaching or suggestion that a MTW type zeolite having a very small crystallite size, i.e., below 0.1 μm, significantly and unexpectedly increases gas oil yields as discovered by Applicant. In the only specific examples in Ballegoy in which a MTW type zeolite was used (Examples 2a, 2b and 2c), Ballegoy employed zeolites having a crystal size of 0.1 or greater and did not produce any significant amounts of gas oil as discussed below.

Distinctions Between Ballegoy and the Presently Claimed Process

Applicant has discovered that by using and MTW type zeolite such as ZSM-12, having a particular crystal size, i.e., smaller than 0.1 μm, it is possible to produce both lubricating base oils and unexpectedly high yields of gas oil, i.e., gas oil yields of <u>at least 20 wt%</u>. Applicant will now explain why the present process would not be obvious to one of ordinary skill in the art based on the teachings of Ballegoy.

Ballegoy is concerned with the production of lubricating base oils in high yields. Ballegoy is not concerned with the production of gas oils and does not contain any express teaching regarding the production of gas oils in high yields, which is a key aspect of Applicant's process. In fact, gas oils are not mentioned anywhere in Ballegoy.

Thus, the question is whether Ballegoy, although containing no express teachings regarding gas oils, inherently produces gas oils in high yields, or suggests to one skilled in the art how to produce gas oils in high yields.

Regarding the question of inherency, Ballegoy admittedly teaches MTW type zeolites, among a large number of other zeolites mentioned above, can be used to produce lubricating base oils in high yields. The only specific examples in which a MTW type zeolite catalyst was actually used to produce a lubricating base oil was in Examples 2a, 2b and 2c, which are described on page 19 of Ballegoy, lines 6-22. The MTW type zeolite used in Examples 2a, 2b and 2c was a ZSM-12 zeolite having an average crystal size of <u>1-2</u> µm for Example 2a, and <u>0.1 to 0.2</u> µm for Examples 2b and 2c. The product characteristics and yields of lubricating base oils produced in Examples 2a, 2b and 2c are presented in Table II on page 20 of the Ballegoy reference. From Table II it can be seen that the yield of lubricating base oil is <u>91</u> wt% for Examples 2a and 2b, and <u>82.4</u> wt% for Example 2c.

Table II does not indicate whether any gas oil was produced in these examples. Applicant concedes there is a possibility some gas oil was produced. However, one thing is clear, the amount of gas oil produced, if any, in these Examples was less than the <u>at least 20</u> wt% recited in the amended claims, since the base oil yield Example 2a and 2b was <u>91</u> wt% and the gas make was 2.9 wt% and 3.6 wt%, respectively. Therefore, the *maximum amount* of gas oil which could have been produced in Example 2a is <u>6.1</u> wt%, which was calculated as follows: 100 wt% - (91 wt% + 2.9 wt%) = 6.1 wt%. The *maximum amount* of gas oil that could have produced in Example 2a is <u>5.4</u> wt %, i.e., 100 wt% - (91 wt% + 3.6 wt%) = 5.4 wt%. In Example 2c the *maximum amount* of gas oil which could have been produced is <u>14</u> wt%, i.e., 100 wt% - (82.4 wt% + 3.6 wt%) = 14 wt%, which is still well below the <u>at least 20 wt%</u> gas oil limitation recited in amended claim 1. Therefore, it can be seen that none of the examples in Ballegoy in which a MTW type zeolite was employed, inherently produced high gas oil yield of <u>at least 20 wt%,</u> as recited in amended claim 1.

Turning now to the question of obviousness, the Examiner's rationale for obviousness is based the following disclosure in Ballegoy, which is cited in the paragraph bridging pages 3 and 4 of the subject Office action:

> "The cut point(s) of the distillate fractions is/are selected that each product distillate recovered has the desired properties for its envisaged application. For lubricating base oils, the cut point will normally be at least 280 °C and will not

> exceed 400 °C, the exact cut point being determined by the desired product properties, such as volatility, viscosity index and pour point." (page 17, lines 14-21)

In the paragraph bridging pages 4 and 5 of the subject Office action the Examiner takes the position that:

> "Since Ballegoy invention discloses that the exact cut point of the distillates is determined by the desired product properties and the lubricating base oil has a boiling range of 280 °C to 400 °C and also since Ballegoy invention uses a feed with a boiling range of 202 to 587 °C (Page 28, Table IX), it would have been obvious to one skilled in the art at the time the invention was made to modify Ballegoy invention and cut a lubricating base oil and a larger portion of gas oil as compared to the lighter fraction because gas oil is a more value-added product as compared to the lighter components."

The above statement reflects a possible misunderstanding as to which variables in the Ballegoy invention determine the <u>amounts</u> of lubricating base oil, gas oil and other end products that are produced. The <u>amount</u> of each of the end products is determined by the <u>catalyst used</u> and the <u>process conditions</u> under which the feed stream is catalytically dewaxed. The cut points <u>do not</u> determine the <u>amount</u> of each end product obtained. Selecting the cut points permits the recovery of whatever amount of end product is present in the particular distillation range selected. If one wants to increase the amount of a particular end product, they must modify the <u>catalyst used</u> and/or the <u>process conditions</u> in order to produce additional product. It is not just a matter of selecting a different cut point as implied in the subject Office action.

For example, the lubricating base oil yield in Example 4 of Ballegoy was 86 wt% with a gas make of 5.7 wt% as shown in Table V on page 24 of Ballegoy. Therefore, the maximum amount of gas oil and other products which were produced in Example 4 is <u>8.3</u> wt% , i.e., 100 wt% - (86 + 5.7 wt%) = 8.3 wt%. Since the majority of the dewaxing effluent in Example 4 is lubricating base oil (i.e., 86 wt%), the only way to significantly increase the amount of gas oil would be to use a <u>different catalyst</u> and/or <u>different process conditions</u> in order to produce less lubricating base oil and more gas oil. One could not significantly increase the gas oil yield by selecting cutting points, as long as the amount of lubricating base oil produced was 86 wt%.

In summary, the Examples in Ballegoy do not inherently produce gas oils in high yields of at least 20 wt%, nor does Ballegoy teach or suggest how gas oils yields of at least 20 wt% can be achieved. The disclosure on page 17, lines 14-21, regarding cutting points does not teach

someone skilled in the art how to produce gas oils in high yields. These yields of lubricating base oil, gas oil and other end products are determined by the catalyst used and the process conditions. Selecting cutting points only allows one to recover the amount of end products produced in each particular distillation range. It does allow you to increase the amount of product produced in a particular boiling range.. Therefore, amended claim 1, which includes the limitation of a high gas oil yield of at least 20 wt%, is not obvious over Ballegoy, alone or in combination with Chen or Young as discussed below.

Chen

The Chen reference is cited for its disclosure in Table 2.1 that MTW crystallites have a channel size 12 and that this indicates the MTW zeolites disclosed in Ballegoy also have a channel size 12. Applicant acknowledges this. However, Applicant points out that Chen, like Ballegoy, makes no mention of gas oils, and does not disclose which of the numerous zeolite structures listed could be used to make lubricating base oils and gas oils in high gas oil yields of at least 20 wt%.

Young

The Young reference is cited as evidence that XRD line broadening is a known technique for determining the average crystal size of zeolite catalysts, which Applicant acknowledges. Otherwise Young has little relevance in that it concerns Y zeolites instead of MTW type zeolites, and does not overcome the deficiency in Ballegoy in failing to teach how to produce gas oils in high yields of at least 20 wt% from a slack wax or a foots oil feed.

Claims 2-9, either directly or indirectly, depend on claim 1 and therefore contain all of the limitations of claim 1, or narrower limitations. These limitations include use of a slack wax or foots oil feed; the use of a MTW type zeolite crystallites having an average crystallite size of smaller than 0.1 and a constraint index larger than 1.0; and yielding a product effluent comprising a base oil fraction and a gas oil fraction wherein the yield of the gas oil fraction is at least 20 wt%, and is larger than the fraction of the product effluent boiling below the gas oil fraction. Since none of the references teach or reasonably suggest the aforementioned combination of limitations, especially the production of a gas oil fraction in a high yield of at least 20 wt% , claims 2 to 9 are patentable for the same reasons as discussed above in connection with claim 1.

CONCLUSION

For all of the above reasons, and in view of the amendments and the comparative showing in Table 2, page 13 of the present specification, it is believed that claims 1-9, as amended, are patentable over the prior art. Accordingly, reconsideration and allowance of these claims is respectfully requested.

Respectfully submitted,

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